cam shaft (#5.4) and six hallow torque pins and needle bearings (#5.5) is the most compact and rigid. The axes bearings (#5.6) are deep-groove ball bearings. As with all the other cyclo gear torque multipliers, the three-wave disk (#5.2) system is the most vibration-free system. All shafts are sealed with lip-seals to allow semi-liquid lubrication for a long gear life.

Figure 6. This schematics shows the invention of an inexpensive absolute rotating encoder or shaft encoder. With the rechargeable battery (#6.4) the LED (#6.2) generates a light beam. The angular rotation encoder (#6.1) has transparent circular windows that let the light path through or stop it. The light will trigger the photo-transistors (#6.3) ON and OFF, making square pulses in the channel A and B. If the Channel A pulse is leading, the up-counter is counting with increasing counts. If the Channel B pulse is leading, then the down-counter is decreasing the counts. The counts represent an axes or gear positions in machine tools, robots, etc. The shift register (#6.5) allows a computer, for instance, to access the counter data for position verification on start up, during calibration of the axes. etc. Because the battery recharges when the machine is powered and the counter is in use, the battery is powering the counter at all times. This arrangement constitutes an inexpensive absolute counter. This system reduces the absolute encoder cost by about 65%. and increases the absolute encoder reliability by a minimum of 300%, because of fewer components in use.

Figure 7. This circuit is a smoothing, anti-oscillating add-on filter for servo systems. Inertia, imbalance, and manufactured imperfection, influence rotating shafts, gears, and machine elements. This imperfection quite often shows up as vibration and oscillation. Servo drives, because of the feedback, stimulate the vibration especially if the servo response is working in a high-gain mode. To minimize or eliminate this problem, the add-on-filter for servo systems was invented.

At the #7.1 node, the servo (correctional) signal enters into the amplifiers. The undamped signal becomes the under-damped signal at the next frequency cycle, and the under-damped (#7.6) curve increases to a saturation point. At node #7.2 (based on the R1, C1 time constant), a shift and an attenuation of the signal will occur. At node #7.3, the feedback signal (coupled by C1 and the R2, R1) is further damped. The damping curve (#7.7) is most desirable. The highly-damped curve (#7.8) is more easily tuned up than the curve (#7.7) for a more specific application.

I claim:

1. A geometrical design arrangement for planet type roller gear. The basic geometrical relationship of the "cyclo-module" to the cyclo housing/roller cage, the cyclo wave disk, and the cam/eccentric dimensions. These geometrical design relations and the realized simplifications are the basic features of these inventions.

2. A geometrical design arrangement for planet type roller gear according to claim 1

wherein: the roller cage has the given relation to the cyclo-module as shown in figure 1.

3. A geometrical design arrangement for planet type roller gears to claim 2: wherein the roller size has a geometrical relation to the cyclo module as indicated under figure 1 .

4. A geometrical design arrangement for planet type roller gears according to claim 3: wherein the eccentric has a geometrical relation to the cyclo module and claim 3.

5. A geometrical design arrangement for planet type roller gear according to claim 4: wherein the wave disk has a geometrical relation to claim 1 - 4.

6. A geometrical design arrangement for planet type roller gears according to claim 5: wherein three eccentrics are spaced equally between the center and the roller cage as shown in drawings figure 3 and 4.

7. A geometrical design arrangement for planet type roller gears according to claim 6: wherein the number of cams are not limited to 1, 2, or 3, The Size of the cyclo assembly and cost will determine if more than three cams are practical.

8. A geometrical design arrangement for planet type roller gears according to claim 7: wherein the cams are spaced to drive out the high torque generated by the cyclo gears wave disk(s) in connection to the cam(s).

9. A geometrical design arrangement for planet type roller gears according to claim 8: wherein the two drive-out flanges are driven by the cams by play-free bearings (figure 3,4).

10. A geometrical design arrangement for planet type roller gears according to claim 9: wherein flange and housing bearings form a unit axes-cyclo-gear-assembly (Figure 3,4,5).

11. A geometrical design arrangement for planet type roller gears according to claim 10: wherein a multitude of rods (torque, stabilizing bars), hallow or solid, stabilize and rigidities the two drive-out flanges as shown in figures 3,4,5. to a coherent gear-driven axis assembly.

12. A geometrical design arrangement for planet type roller gears according to claim 11: wherein a single or pair of deep groove or a cross-roller bearing is used to stabilize the high torque flange to the gear housing, as in Figure 2, to make the gear assembly an axis or turntable.

13. A geometrical design arrangement for planet type roller gears according to claim 12: wherein all hallow cyclo rollers are securely positioned with pins to the roller cage as shown in figure 1 - 5.

14. A geometrical design arrangement for planet type roller gears according to claim 1 to13: wherein position accuracy by the use of the cyclo gear assembly is further enhanced by controlling its position. To know the rotation position at any time by adding an absolute shaft encoder to the gear axis drive-in or drive-out, depending on the use of the cyclo gear drive/axis, as shown on figure 6. This is a very important and useful feature and a very worthwhile claim.

15. A geometrical design arrangement for planet type roller gears according to claim 14: wherein the absolute angular encoder, consisting of a permanently battery power backed "On" encoder up/down counter with accessible shift register / memory is added as shown in Figure 5.

16. A geometrical design arrangement for planet type roller gears according to claim15: wherein the analog summing circuits and feed-back servo circuit often feeds back data misdirecting the summing results and therefor the servo action. The figure 7 frequency and servo filter counteracts irrelevant signals and enhances further the productivity and performance of the cyclo torque multiplier and cyclo gear axis.

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